Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

SEXUAL IMMOBILITY AS A CAUSE OF THE DEVELOPMENT OF THE SPOROPHYTE.

BY CONWAY MACMILLAN.

IN the *Annals of Botany*, August, 1890, are to be found two very interesting papers on the altërnation of generations in plants. One is by Professor F. O. Bowers, who defends Alakovsky's distinction between antithetic and homologous alternation; the other by the late J. Reynolds Vaizey, who shows the impossibility of establishing homologies between sporophores and oöphores. Each of these papers presents somewhat more clearly than usual the problems which underlie all attempts at a general coördination of vascular plants, mosses, and the lower algæ, and in each of them there is some effort to account for the origin of the phenomenon of alternation itself. Bowers is inclined to ascribe entirely different causes to the sporophyte of the Archegoniatæ and the so-called sporophytic plants of Vaucheria, Mucor, or Œdogonium. These latter he conceives to be modified oöphytes,—or gametophytes, to use his terminology,—while the former is an interpolated plant, altogether devoid of homologies with the gametophyte of its own species or that of any other. To the sporophyte of the Archegoniatæ he ascribes change of habit from aqueous to subaërial nutritive media as the producing cause, and proceeds to adduce morphological and phylogenetical evidence in support of the position. The purpose of this brief note is to indicate an opinion of the writer that something quite different, and not altogether overlooked by Bowers, is possibly the sufficient cause for the development of sporophytes, not only in the Archegoniatæ, but wherever sporophytes are developed at all.

In the first place, it should not be overlooked that in animals higher than the Medusæ and Flat Worms (with rare exceptions, *e.g.*, Salpa ?)[1] there is nothing comparable with the alternation of generations—that rhythmic succession of sexual and asexual individuals—which continues with perfect distinctness even into the order Compositæ,—according to Luerssen, the highest family of plants. Why, now, there should be such a rhythm in plants and not in animals is a point to be explained, and very likely the explanation will throw light upon the origin and perpetuation of alternation in the vegetable kingdom. It is of no use to say, as Geddes does, quoted by Bowers, that alternation is "a rhythm between relatively anabolic and katabolic preponderance." For why should such rhythm exist in plants and not in animals? In fine, there seems to be but one explanation readily entertained, and that is this: *Alternation of generations is a phenomenon conditioned upon individual immobility.* It is readily discovered that in almost every species of animal free to move where it pleases alternation is not seen, while in many of the somewhat fixed and immobile alternation is apparent,—for example, in the Cœlenterates. And in the more mobile plants alternation is either indistinct (homologous) or scarcely apparent, while in the more immobile plants alternation becomes exceedingly distinct, and reaches its highest type in in the most immobile plants. Now the sexual act, being conditioned upon the approach to each other of the gametangia or gametes themselves, is accomplished with greater and greater difficulty the more complete the immobility of the sexual individual. In animals immobility is at its maximum; in the higher plants—notably most Angiosperms—it is at its minimum. In other words, the sexual act is easiest of accomplishment in animals, speaking generally, and most difficult in the higher plants; consequently the egg, in animals, is easily produced, but in a plant of the Archegoniate series an egg is produced with great difficulty. In spite of the high gonotropic specializations in other plants, probably not a millionth part of the sexual individuals produced ever accomplish their end. For this reason the egg of an animal is, on the whole, a *cheap* product; the egg of an Archegoniate plant is an *expensive* product.

---

[1] The alternation in plant-lice (Aphidæ) is a different matter entirely, and need not be considered here.

From the considerations outlined above we have no difficulty in perceiving the physiological conditions which lead to the appearance and to the great development of the sporophyte. In Œdogonium the egg divided into four swarm-spores. For one sexual act four plants may be obtained. In Chara the number of spores produced directly from the egg is still greater, and the carpogone wall becomes thickened and specialized as a covering to protect the result of the sexual act. In Riccia the egg itself develops an epidermal layer, besides the spore-mother-cells within. As the number of these spores becomes greater a columella is required to strengthen the capsule; it appears in the Anthocerotæ. To scatter the spores better the capsule is elevated on a stalk in the Jungermanniæ. To the same end elaters are developed in the Hepaticæ (and later in the Equisetaceæ). The stalk of the capsule becomes longer and the whole sporophyte more complex in the Musci. In the ferns, leaves and roots are assumed by the sporophyte, in order that (having access to more nutriment) it may produce more spores. Throughout the whole upward series of developing, specializing, progressing sporophytes we see one distinct end in view, viz., the making of an egg, when fertilized, go as far as possible.

Now whether there is any difference between the sporophyte developed, under these conditions, in an aquatic plant like Chara or Coleochæte, and the sporophyte developed under exactly similar conditions in an amphibious plant like Ophioglossum, I cannot say. Certainly in either case the meaning of the sporophyte remains the same. It is, wherever we meet it, whether in Chara or in Juglans, in Œdogonium or Taxus, a device for making the most out of that sexual act accomplished with so much difficulty, and with the chances so tremendously against successful consummation.

If the correct explanation of the origin of sporophytes is given above, it is difficult to see why a sporophyte should not in every case be considered an "interpolation" between successive gametophytes. Wherever met, the sporophyte is simply more or less elaborate subdivision of the fertilized egg. In Œdogonium it is a direct subdivision; in Helianthus it is an indirect subdivision. Properly speaking, the gametophyte is the *plant;* the sporophyte is, at its greatest development, nothing more than a highly complicated, self-supporting *pod.*

The sporophyte, then, may be considered in its widest sense as *a result of vegetative reproduction applied to the fertilized egg.* As the thallus of Marchantia is cut into gemmæ, so the egg of Marchantia may be cut into the cells of the sporophyte. The strict analogy of sporophytes is, I suppose, not questioned. The question as to their homology must be studied from the physiological point of view, as well as through the researches of anatomists and embryologists. Without either dissenting from or endorsing the view of Bowers, the writer has tried only to show that emphasis may be laid upon conditions surrounding the sexual act as a help to a clearer comprehension of the phenomena of alternation.

A COMMENSAL ANNELID.

BY E. A. ANDREWS, PH.D.

CASES in which Annelids are believed to live more or less directly dependent upon other Annelids, upon Crustacea, Gasteropods, Echinoderms, and even upon Cœlenterates, are not unknown, but yet form by far the exception rather than the rule in the economy of this group. Of the reported cases some must be regarded as mere temporary refuge of Annelids in cavities offered by the shells or bodies of other creatures; some are such mechanical associations as are presented in the complicated assemblage of various Annelid tubes in sponges or molluscan shells, etc.; while yet others—and these are few—are illustrations of true commensalism, which may pass over into parasitism, as in the Oliognathus living in Bonellia, the Hæmatocleptes living within another Annelid, or the well-known Alciope living inside Ctenophores.

In 1885 Dr. Brooks called my attention to a very interesting case of commensalism involving an Annelid found at Beaufort, N. C., and which is complicated by the fact that three diverse